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P.O. Box 1450, Alexandria VA 20313-1450
Signature Isabel R. Lincoln Date signed: February 15, 2008
Isabel R. Lincoln

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:		)	
	SATO, Yoshitaka et al	)	Examiner:
FILED:	September 6, 2005	)	James Pilkington
SERIAL NO:	10/523,708	)	Richard Ridley, SPE
DOCKET:	GUA UTO 318	)	Art Unit: 3682
FOR:	TRANSMISSION BELT	)	

RESPONSE TO NOTIFICATION OF
NON-COMPLIANT
APPEAL BRIEF UNDER 37 CFR §41.37

Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Notification of Non-Compliant Appeal Brief mailed January 24, 2008, Appellant encloses an amended copy of the Appeal Brief Under 37 CFR §41.27 sent December 7, 2007.

Appellant has amended the Appeal Brief responsive to item 6 regarding separate headings for each ground of rejection. The format of the Argument of the Brief has now been arranged under separate headings corresponding to one or more of the three grounds of rejection, without altering the Argument as presented originally. In response to item 8, Appellant has amended the Evidence Appendix and attached a copy of the Declaration of Paul N. Dunlap dated June 21, 2007 as submitted to the Examiner on June 22, 2007 and made of record. It is submitted that the Brief is in compliance with 37 CFR §41.37 (c) (1) (vii) and (ix) and all other sections of 37 CFR §41. The Office is now respectfully requested to address the merits of this appeal without further delay.

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APPEAL BRIEF UNDER 37 CFR §41.37

Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Appellants filed a Notice of Appeal for the above-identified application on August 3, 2007, appealing the final rejection of claims 1-11 and 13-15. Under 37 CFR §41.37, Appellants respectfully submit this Appeal Brief in triplicate to the Board of Patent Appeals and Interferences (Board). Annexed to this Appeal Brief and labeled Claims Appendix is a copy of rejected claims 1-11 and 13-15. Please charge any fees for filing this Appeal Brief as provided in 37 CFR §41.20 to Appellants' deposit account no. 07-0475.

Real Party in Interest

The real party in interest for the above-identified patent application is The Gates Corporation.

Related Appeals and Interferences

There are no other appeals or interferences known to Appellants, Appellants' legal representative or Assignee that will directly affect or be directly affected by or have a bearing upon the Board's decision in the pending appeal of the above-identified patent application.

Status of Claims

Claims 1-11 and 13-15 are pending in the above-identified patent application. Claims 1-11 and 13-15 remain rejected by the Examiner as set forth in the Final Office Action dated April 4, 2007

and Advisory Action dated July 6, 2007. Claim 12 has been withdrawn. Claims 1-11 and 13-15 are the subject of this Appeal.

Status of Amendments

There have not been any amendments filed subsequent to the Final Office Action.

Summary of Claimed Subject Matter

The present invention as embodied in claims 1-11 is directed to a transmission belt (10) formed from a belt body molded from a stock rubber (11, 12) [page 5, lines 16-21 appln]; chopped aramid fibers (20) that are intermixed in the belt body and oriented in a predetermined direction of the belt body [page 2, lines 14-16; page 4, lines 2-5 appln]; chopped polyester fibers (20) that are intermixed in the belt body and oriented in said predetermined direction [page 2, lines 17-18; page 4, lines 2-5 appln]; and wherein the chopped polyester fibers are longer than the chopped aramid fibers [page 2, lines 18-20; page 4, lines 2-5 appln]. Certain preferred embodiments of the invention dependent upon claim 1 include:

- wherein the chopped aramid fibers and the chopped polyester fibers are oriented in a width (transverse) direction of the belt body [claim 2]
- wherein the length of the chopped aramid fibers is less than 3 mm [claim 4]
- wherein the length of the chopped polyester fibers is less than 5 mm [claim 5]
- wherein the chopped polyester fibers are subjected to an RFL (resorcinol-formalin-latex) coating treatment [claim 7]
- wherein the chopped polyester fibers are chosen from PET and other specific polyesters [claim 8]
- wherein the transmission belt is a V-belt [claim 10] or cogged V-belt [claim 11].

As embodied in the remaining independent claim, claim 13, the present invention is drawn to a power transmission belt (10) of the single strand cogged (15, Fig. 2) V-belt type including a belt body molded from a stock rubber (11, 12) [page 5, line 16 through page 6, line 3 appln], comprising a top rubber layer (11), a bottom rubber layer (12), and a cord (14) extending in the longitudinal direction of the belt embedded between the top and bottom rubber layers [page 5, lines 21-23 appln], the bottom rubber layer (12) being provided with cogs (15) formed in wave shapes in the longitudinal direction of the belt [page 6, lines 1-3 appln]; chopped aramid fibers (20) that are intermixed in the belt body in both of the top and bottom rubber layers (11, 12), and oriented in a predetermined

direction of the belt body [page 2, lines 14-16; page 4, lines 2-5; page 6, lines 4-7 appln]; chopped polyester fibers (20) that are intermixed in the belt body in both of the top and bottom rubber layers (11, 12) and which are oriented in the predetermined direction [page 2, lines 17-18; page 4, lines 2-5; page 6, lines 4-7 appln]; and wherein the chopped polyester fibers (20) have a length which is longer than the chopped aramid fibers [page 2, lines 18-20; page 4, lines 2-5; page 6, lines 7-9 appln] . The claims dependent on claim 13 specifically further provide:

- the length of the chopped aramid fibers is less than 3 mm; the length of the polyester fibers is less than 5 mm; the orientation of both of the chopped aramid fibers and chopped polyester fibers is transverse to the running direction of the belt; and 5 to 30 parts by total weight of the chopped aramid fibers and the chopped polyester fibers are intermixed in the stock rubber per 100 parts rubber [claim 14]
- the above recited subject matter of claim 14 further specifying that the stock rubber is formed of EPDM, in which an organic metal salt is mixed, and the belt is used in the transmission of a scooter [claim 15].

The thrust of the subject invention is to provide a transmission belt, such as for a scooter transmission, with improved durability [page 2, lines 11-12 appln]. Scooter transmission belts were known formed of chloroprene rubber with chopped para-aramid fibers intermixed in the rubber of the V-belt and oriented transversely to improve the belt's strength with respect to lateral pressure. However, such belts still did not have satisfactory durability [page 1, lines 11-22 appln]. While longer aramid fibers would be expected to improve the orientation of the fiber and durability of the V-belt, this was not possible to implement in practice because the chopped aramid fiber does not disperse properly within the stock rubber, leading to difficulties in molding the belt.

The claimed invention is based on the discovery that by using a particular blend of aramid and polyester fibers intermixed in the stock rubber, with relative length dimensions such that the polyester fibers are longer than the aramid fibers, one is able to significantly improve belt durability [Fig. 9 appln] by improving key operating parameters of a power transmission belt that lead to improved durability. These operating parameters include markedly increased tensile modulus [note particularly Figs. 3 and 4 appln], compression strength [Fig. 5 appln], favorable friction coefficient characteristic [Fig. 6 appln], hardness and tension [Figs. 10 and 11 appln] and heat resistance [Fig. 12].

The inventors have found that tensile and compression strength, important factors for durability, were improved by blending relatively short aramid fibers with relatively longer polyester fibers in the rubber matrix, without sacrificing dispersability of the fibers, or moldability of the belt.

The inventors believe that presence of the relatively longer polyester fibers enhances orientation of the aramid fibers in the same direction as the polyester fibers during molding, thus improving strength against lateral pressure which the belt experiences in a transmission drive, such as in a scooter drive [page 6, line 19 to page 7, line 24, appln].

As will be gleaned from the durability comparison depicted in Fig. 9 of the application, the belt of the invention conforming to Example A, described on page 10 of the application, in contrast to the standard commercially available scooter belt described in the paragraph spanning pages 15 and 16 of the application, was characterized by a dramatic improvement in durability. The conventional polychloroprene rubber scooter belt, which contained 21 parts by weight of chopped aramid fibers having a length of 1 mm ran <u>320 hours</u> on the durability test described in the paragraph spanning pages 17 and 18 of the application. In contrast, Example A of the invention, which used an EPDM rubber stock and 10 parts by weight of aramid fiber having the length of 1 mm, blended with 10 parts by weight of polyester fiber having the length of 3 mm, ran <u>680 hours</u> on the same durability test.

Grounds of Rejection to be Reviewed on Appeal

1. Whether the rejection of claims 1-7, 9-11 and 13-14 under 35 USC §103(a) as being unpatentable over Ito USP 2001/0039226 ("Ito '226"), in view of Kumazaki et al USP 5,674,143 ("Kumazaki et al '143") should be sustained.
2. Whether the rejection of claim 8 under 35 USC §103(a) as being unpatentable over Ito '226 in view of Kumazaki et al '143 and further in view of Kodama USP 5,908,520 ("Kodama '520") should be sustained.
3. Whether the rejection of claim 15 under 35 USC §103(a) as being unpatentable over Ito '226 in view of Kumazaki et al '143 and further in view of Kinoshita USP 6,132,328 ("Kinoshita '328") should be sustained.

Grouping of Claims

The rejected claims do not stand or fall together for each ground of rejection which Appellants contest. It is requested that the patentability of each individual claim be considered on its merits as argued below.

Argument

[Relates to the first ground of rejection]:

Whether the rejection of claims 1-7, 9-11 and 13-14 under 35 USC §103(a) as being unpatentable over Ito USP 2001/0039226 ("Ito '226"), in view of Kumazaki et al USP 5,674,143 ("Kumazaki et al '143") should be sustained.

I THE EXAMINER HAS FAILED TO ESTABLISH A *PRIMA FACIE* CASE OF OBVIOUSNESS UNDER 35 USC §103(a) OF EACH OF THE REJECTED CLAIMS 1-7, 9-11 AND 13-14.

It is well established under patent law that the Examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. Thus, the Examiner has the burden of going forward with the production of evidence that the claimed combination of the rejected claims is obvious in the sense of 35 USC §103(a). See In re Rinehart, 189 USPQ 143 (CCPA 1976). Similarly, the Examiner must provide some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. In re Kahn, 441 F. 3d 977, 988 (Fed. Cir. 2006). (cited with approval in KSR Int'l v. Teleflex Inc., 127 S. Ct. 1727, 1740-41, 82 USPQ 2d 1385, 1396 (U.S Supreme Court 2007)). As a corollary to the foregoing, the Examiner must articulate an adequate rationale for combining Ito '226 with Kumazaki et al '143 in the manner asserted to meet the claimed invention.

While the Supreme Court in *KSR* did not totally reject the use of "teaching, suggestion or motivation", as a factor in the obviousness analysis, it did reject a rigid application of the "teaching, suggestion or motivation" test. The Court noted that the analysis supporting a rejection under 35 USC §103(a) should be made explicit, and that it was "important to identify a reason that would have prompted a person of ordinary skill in the relevant to combine the [prior art] elements in the manner claimed". The Court specifically stated:

> Often it will be necessary ... to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a person having ordinary skill in the art, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit.

KSR, slip op at 14 (emphasis added).

The foregoing statement of the law, which has been adopted by the USPTO in its Memorandum dated May 3, 2007 to the Technology Center Directors, from Margaret A. Focarino, Deputy Commissioner for Patent Operations, will be followed here in analyzing the propriety of the

rejection.

Claim 1

All of the claim limitations must be taught or suggested by the prior art to establish *prima facie* obviousness of the claimed invention. In re Royka, 180 USPQ 580 (CCPA 1974). In the present case, Appellants are claiming a transmission belt comprising a blend of longer polyester fibers with shorter aramid fibers intermixed in the rubber body of the belt. As the Examiner has acknowledged during prosecution, Ito '226 fails to disclose that the belt body is made of both aramid fibers and polyester fibers blended in the rubber body. The Examiner has combined Kumazaki et al '143 to attempt to supply the deficiency.

But it is also clear that Kumazaki et al '143 fails to disclose use of blends of fibers having differential fiber lengths, and in particular fails to disclose a blend of aramid fibers and polyester fibers in which the polyester fibers have relatively longer lengths than the aramid fibers forming the blend. Kumazaki et al '143 generally states that the fibers are formed by cutting long synthetic or natural fibers to a length of 2-6 mm (col. 4, lines 44-47). The reference further states that para-aramid fibers can be used alone, or that natural fibers, such as cotton and pulp, may also be used alone (and note Example 3 in Table 1 in column 7 of Kumazaki et al '143 where nylon short fibers are used alone). The reference also discloses use of blends of para-aramid fibers with nylon, vinylon, polyester or meta-aramid fibers. Thus, a fair reading of this reference suggests that various synthetic or natural reinforcing fibers can be used alone or in combination with para-aramid fibers [Kumazaki et al '143 at col. 4, lines 44-55].

The Examiner during prosecution attempted to make up for this deficiency by interpreting paragraph [0052] in Ito '226 as disclosing the use of longer polyester fibers, than aramid fibers. It is submitted that this is not a reasonable interpretation of the disclosure in Ito '226. A fair interpretation, when read as a whole, is that a single fiber rather than a blend of fibers, is employed, and that the preferred fiber used alone is an aramid fiber having a length in the range of 1 to 10 mm, preferably from 3 to 5 mm. The Ito '226 patent further states that when using [the less preferred] polyamide fibers, polyester fibers or cotton fibers, one preferably selects a fiber length of from 5 to 10 mm. Thus, a fair reading of Ito '226 is that the reference generally suggests use of a single fiber type in the 1 to 10 mm range, however, aramid fibers are preferred and if they are used, the length is preferably from 3 to 5 mm. However, if one of the less preferred alternative fibers, including polyester fibers, is selected, fiber length is preferably maintained from 5 to 10 mm. This passage does not disclose or suggest the use of a blend of aramid and polyester fibers using relatively longer polyester fibers with relatively shorter aramid fibers.

Thus, to make out a *prima facie* case, the Examiner must modify the teaching of Ito '226 and Kumazaki et al '143. This is the first of three criteria set forth in MPEP §2143 to assess the appropriateness of combining references in a particular fashion. Pursuant to MPEP §2143, the first of three criteria requires some suggestion or motivation (or an apparent reason per *KSR* citation above), either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify a reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, as the third criteria, the prior art combination of references must teach or suggest all the claim limitations. However, the Examiner has not come forth with any objective evidence suggesting why the teachings of Ito '226 and Kumazaki et al '143 should be modified to meet the claim limitations as proposed by the Examiner. It is submitted that the Examiner can explain such modification only through hindsight reconstruction of Appellants' claim from the prior art. It is improper to use the inventors' patent specification as an instruction book on how to reconstruct the prior art. Panduit v. Dennison Mfg. Co., 1 USPQ 2d 1593 (Fed. Cir. 1987).

Indeed, the Examiner has conceded in this case that he did employ a hindsight approach:

> "[I]t must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the Applicant's disclosure, such a reconstruction is proper. " [Final Office Action, ¶9, April 4, 2007 citing In re McLaughlin, 443 F. 2d 1392, 170 USPQ 209 (CCPA 1971)].

Nevertheless a *prima facie* case can still be made out if the knowledge generally available to one of ordinary skill in the art would lead to modification of the applied references as proposed. The Examiner has not submitted any evidence to support this specific modification. Stated otherwise, the test mandated by *In re Kahn*, that the Examiner must provide some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness has not been made. Nor has the apparent reason to combine the known elements in the fashion claimed by the Examiner been advanced, with an explicit supporting analysis, according to the *KSR* test.

In accordance with MPEP §2143.01, there must be some teaching in the art or the applied Ito '226 or Kumazaki et al '143 references to motivate making of the combination as claimed or supply that apparent reason under *KSR*. Motivation in turn, can come from one of three possible sources: the nature of the problem to be solved, the teachings of the prior art, and the knowledge of a person of ordinary skill in the art. In re Rouffet, 47 USPQ 2d 1453, 1457-58 (Fed. Cir. 1998).

We have seen nothing in the applied references of Ito '226 or Kumazaki et al '143, nor in

the prior art generally, to motivate one skilled in the art to make the combination suggested by the Examiner. Appellants would concede the existence of necessary motivation to make the combination, if there were a reasonable expectation of success - - but that is absent here. In this case, why would someone skilled in the art, familiar with the teaching of Ito '226 suggesting use of single fiber loading in a cogged V-belt, be led to modify that teaching by using one of the possible blends of fiber disclosed as an alternative in Kumazaki et al '143? If the use of blends of certain fibers as disclosed in Kumazaki et al '143 would be expected to provide improved results over use of single fibers, that would provide the reasonable expectation of success prompting possible modification of Ito '226 disclosure from use of single fibers to fiber blends. However, there is nothing in the specification of Kumazaki et al '143 favoring, or promoting the use of blends of para-aramid fiber with other fibers, including polyester, over use of para-aramid fibers alone, natural fibers such as cotton or pulp, or even other synthetic fibers such as nylon alone [col. 4, lines 44-55; col. 7, Table 1; and col. 8, Table 2].

The Board's attention is directed to the working examples set forth in Kumazaki et al '143 starting at the bottom of column 6 of the specification. As set forth in Table 1 at the top of column 7, reproduced below, three different rubber compositions used in Kumazaki et al '143 belts are listed. Attention is directed to Example 1, which utilizes a blend of 13 phr (parts per 100 parts rubber) aramid short fibers, with 7 phr nylon short fibers, and Example 3 which utilizes a single fiber, nylon short fibers present in the amount of 20 phr. In his Final Rejection, the Examiner argues that Kumazaki et al '143 would lead the ordinary skilled man in the art to employ a blend of fibers to improve durability of the belt, the main objective in the subject application. However, there is no teaching in Kumazaki et al '143 that blends of aramid with any other fiber will improve durability of the belt.

Table 1

TABLE 1

Ingredients	Example 1	Example 2	Example 3
Chloroprene rubber	100	100	100
Zinc oxide	5	5	5
Stearic acid	2	2	2
Carbon black FEF	50	35	35
Aramid short fibers	13	7	—
Nylon short fibers	7	15	20
Microcrystalline wax	1	—	—
Plasticizer	6	6	6
Accelerator	1	1	1

Referring now to the results shown in Table 2, reproduced below, Example 1 utilizing compound 1 (Example 1) with a rib angle of 42.5° (an important criteria taught by Kumazaki et al '143), is compared with Comparative Example 3 utilizing the same rib angle of 42.5°. The resultant durability at high temperature is 300 hours for Example 1 using a blend of aramid and nylon short fibers, compared with a durability at high temperature of 335 hours for Comparative Example 3 using compound 3, i.e. 20 phr nylon short fibers only, not blended with aramid or any other fibers. The results for durability at low temperature are slightly reversed. If the total durability hours for both high and low temperatures are added together, Comparative Example 3 (335 hours plus 35 hours = 370 hours) still exceeds the durability of the Example 1 belt using the blend of aramid and nylon fibers (300 hours + 46 hours = 346 hours). The conclusion is clear: Kumazaki et al '143 does not provide any reasonable expectation of success, or preference, if blends of fibers are used in his belt matrix, compared to fibers of a single type. Indeed, the clear thrust of the teaching of Kumazaki et al '143 is twofold: (i) use of facing surfaces on the pulleys which make an angle with each other of about 2° - 10° less than the included angle made by the side surfaces of the belt, i.e., use of a force fit, and (ii) use of fibrillized portions of the fibers projecting from the side surfaces of the belt [Fig. 2]. Clearly, there is no suggestion or motivation provided one skilled in the art to select blends of fibers (over single fiber type) to incorporate into the rubber matrix of a belt, from the teaching of Kumazaki et al '143.

Table 2

TABLE 2

	Example		Comparative Example		
	1	2	1	2	3
Compound No.	1	1	1	2	3
Rib angle (°)	42.5	44.5	40	40	42.5
Overtension for noise	6.5	6.5	6.5	6.0	6.0
6% slip (amount of wear, g)	0.38	0.42	0.34	0.42	0.45
Speed variation (amount of wear, g)	0.24	0.24	0.24	0.22	0.26
Durability at high temperature (h)	300	313	286	320	335
Durability at low temperature (h)	46	67	51	42	35

The third and last source for possible motivation to combine Ito '226 and Kumazaki et al '143 in the manner proposed by the Examiner, comes from the nature of the problem to be solved. When this source is examined, it is submitted that each of the subject invention, Ito '226 and Kumazaki '143, while all pertaining to power transmission belts, each address distinct and separate problems.

The problem address by Ito '226 is <u>crack generation</u> particularly at the cog trough region, or in the cog crest, where such cracks can initiate and propagate, and result in flex fatigue failure or breakage of the belt [see paragraphs [007] – [0011]). Kumazaki et al '143, on the other hand, is concerned with <u>abatement of noise in a V-ribbed belt</u> [see col. 1, lines 5-11; lines 65-67; col. 2, lines 1-22; lines 28-31; col. 5, lines 1-9; col. 6, lines 50-54; and elsewhere]. Thus, neither of the principal references applied in the combination rejection under 35 USC §103 (Ito '226 and Kumazaki et al '143,) address even remotely similar problems confronting power transmission belts. This can be explained as the belts disclosed and which serve as the focus in the different references are of distinct types – one is a traditional cogged V-belt (Ito '226) and the other is a V-ribbed belt (Kumazaki et al '143). V-belts and V-ribbed belts are dissimilar structurally, function differently and possess distinct modes of operation.

In contrast, the problem addressed by the claimed invention, <u>durability</u> of a side drive V-belt, such as used in a scooter drive application, concerns such underlying factors as tensile strength, modulus and compression stress resistance, among other parameters, not considered as problems in the applied references. The Examiner has suggested from the passage at the top of col. 5, lines 1-9 of Kumazaki et al '143, that that reference is directed to the problem of belt durability. With all due respect, it is submitted that that passage is primarily concerned with <u>noise reduction</u> to satisfactory levels <u>without adversely affecting durability</u> of the belt. That is, the

reference is not addressing improvement of durability, but rather noise abatement without significantly adversely affecting durability. We have seen from the results set forth in Table 2 of Kumazaki et al '143 that the durability of the example belt using a blend of aramid and nylon fibers (Example 1) was not improved over the durability of a belt using nylon fibers alone (Comparative Example 3). Clearly, there is no motivation, or apparent reason, to one having ordinary skill in the art to modify Ito '226 by selecting a specific blend of fibers rather than the single type of fibers taught in Ito '226.

The problem confronted by the inventor(s) must be considered in determining whether it would have been obvious to combine references in order to solve that problem. In re Northern Telecom Inc. v. Datapoint Corp., 15 USPQ 2d 1321 (Fed. Cir. 1990). When neither of the applied references confronts Appellants' problem of V-belt durability head-on, why would one skilled in the art turn to these applied references to solve the durability problem?

Claim 2

Claim 2 is dependent on claim 1 and adds the feature that the chopped aramid fibers and the chopped polyester fibers are oriented in a width direction of the belt body. Such orientation improves tensile and compression strength in a V-belt. For the same reason presented above that a *prima facie* case of obviousness was not made out with respect to claim 1, the same applies in respect to claim 2.

The Examiner argues that Ito '226 discloses that the aramid fibers or polyester fibers disclosed in that reference are "oriented in a width direction of said belt body", relying upon the passage at page 3, paragraph [0053]. However, paragraph [0053] of Ito '226 does not state that the fibers should be aligned in the width direction of the belt, but rather that they are aligned "... to be orthogonal to a longitudinally extending line L." "Orthogonal" means perpendicular. Ito '226 is saying that the fibers could be aligned in any direction perpendicular to the line L (depicted in Fig. 1 of the reference). Thus, the fibers could be aligned, for instance, vertically in the sense of the cross sectional drawing shown in Fig. 1 of the reference. This would not be in the direction of the width of the belt, as called for in claim 2. Indeed, the locus of all lines perpendicular to a line (L) would be a plane perpendicular to line L. There would thus be an infinite number of directions in which the fibers could be oriented, and still be "orthogonal" to line L.

It is possible for a patent, namely Ito '226, to include a wide variety of subject matter but at the same time not to disclose a particular subject matter. In re Luvisi, 144 USPQ 646, 650 (CCPA 1965). There is no specific disclosure nor suggestion, in Ito '226 to align his fiber loading in a width direction of the belt body, as called for in claim 2.

Claim 4

Claim 4 specifies that the length of the chopped aramid fibers is less than 3 mm. For the same reasons presented in the argument relating to claim 1 above, it is submitted that the Examiner has not made out a *prima facie* case of obviousness against claim 4, which is dependent on claim 1.

While it is conceded that Ito '226 broadly discloses use of a fiber whose length is in the range of 1 to 10 mm, he clearly states that aramid fibers having a length of 3 to 5 mm are preferred (page 3, paragraph [0052]). Thus, those skilled in the art would be directed to use an aramid fiber having a length above that set forth in claim 4. Therefore, it would not be obvious to use aramid fibers, of less than 3 mm in length, in combination with longer polyester fibers in the rubber stock.

Claim 5

Claim 5 specifies that the length of the chopped polyester fibers is less than 5 mm. For the same reasons presented in the argument relating to claim 1 above, it is submitted that the Examiner has not made out a *prima facie* case of obviousness against claim 5, which is dependent on claim 1.

While it is conceded that Ito '226 broadly discloses use of a fiber whose length is in the range of 1 to 10 mm, he clearly states that polyester fibers having a length of 5 to 10 mm are preferred (page 3, paragraph [0052]). Thus, those skilled in the art would be directed to use a polyester fiber having a greater length than that specified in claim 5. Therefore, it would not be obvious to use polyester fibers, of less than 5 mm in length, in combination with shorter aramid fibers in the rubber stock.

Claim 7

Claim 7, dependent upon claim 1, further provides that the chopped polyester fibers are subjected to an RFL (resorcinol-formalin-latex) coating treatment. This treatment provides the necessary bonding between the fibers and rubber matrix to give it strength, hence enhanced durability.

Appellants rely upon the argument presented above in claim 1 that a *prima facie* case of obviousness has not been made out in claim 7, dependent on claim 1.

In addition, the Examiner relies upon the disclosure in Ito '226 at page 3, paragraph [0055], for disclosing that the polyester fibers are subjected to an RFL coating treatment. Appellants disagree with the Examiner's position. Paragraph [0055] of Ito '226 is solely related to providing an

an RFL treatment of the canvas reinforcing fabric 90 (see Fig. 1) of the belt of Ito '226 not with treatment of the individual embedded reinforcing fibers 114.

There is no disclosure in Ito '226, or suggestion, to treat his reinforcing polyester fibers 114 with an RFL coating. A *prima facie* case has not been made out against claim 7.

Claims 10 and 11

Claim 10 is dependent upon claim 1 and specifies a V-belt. Similarly, claim 11, dependent on claim 1, calls for a cogged V-belt. Appellants submit, for the same reasons provided under claim 1 above, that the Examiner has failed to sustain his burden of proving claims 10 and 11 as *prima facie* obvious under 35 USC §103.

It is conceded that the primary reference Ito '226 discloses both a V-belt and a cogged V-belt. However, as discussed above, Ito '226 fails to disclose certain key limitations in the claims, particularly the use of a blend of aramid and polyester fibers, and does not disclose the use of relatively longer polyester fibers in admixture with relatively shorter aramid fibers, in the rubber stock. Thus, the Examiner must combine Kumazaki et al '143 with Ito '226. However, in doing so, it is clear that the construction, and objectives, of the secondary reference Kumazaki et al '143 are directed to a problem germane to V-ribbed belts, not the V-belt of claim 10 or the cogged V-belt of claim 11.

It is submitted that one skilled in the art, attempting to solve the durability issue of V- or cogged V-belts as presented in the instant specification, would not turn to another belt patent that is directed to a different category or genus of belt, namely, a multi-ribbed belt, that operates fundamentally differently in a power transmission drive.

A V-belt and a cogged V-belt, such as used in a scooter belt transmission [Fig. 14, appln], is subjected to significant transverse forces as the belt rides up and down in a variable speed drive pulley, to change the gear ratio of that drive. In sharp contrast, V-ribbed belts, as disclosed in Kumazaki et al '143, are not side-driven, but each of the V-ribs is wedged into the pulley, and there is no gear ratio change since the belt cannot ride up and down in the pulley.

Claim 13

Independent claim 13 is directed to a power transmission belt of the single strand cogged V-belt type, and contains within the claim each of the key limitations that are also contained in claim 1, in addition to other claim limitations. Thus, all the arguments made in respect to the failure to present a *prima facie* case of obviousness of claim 1, above, apply equally to claim 13.

In the case of claim 13, the belt body is defined in terms of a top rubber layer and a bottom

rubber layer and a cord extending in the longitudinal direction of the belt embedded between the top rubber layer and the bottom rubber layer. The bottom rubber layer is provided with the aforementioned cogs, formed in wave shape in the longitudinal direction of the belt. The claim further specifies that the mixture of chopped aramid fibers in a relatively short length is blended with polyester fibers of relatively long length. These are contained in both the top rubber layer and the bottom rubber layer (i.e. within such cogs).

The Examiner in his Final Office Action has refused to give any weight to the recitation "a single strand cogged V-belt" as it occurs in the preamble. This constitutes error. The Examiner incorrectly states that this preamble recitation is not generally accorded any patentable weight in this particular situation. In fact, the body of the claim (subsection (a)), which refers to the cogs contained in the bottom layer of the belt body, depends upon the preambles' recitation of a "cogged" V-belt for completeness. It is the cogs of the cogged V-belt that contain the embedded blend of relatively short aramid fibers with relatively long polyester fibers. This is a clear structural limitation.

It will also be noted that the Examiner must rely on the secondary reference of Kumazaki et al '143, to attempt to meet his *prima facie* case of obviousness. However, Kumazaki et al '143 does not apply to "V-belts" or "cogged V-belts", and certainly does not suggest a <u>single</u> stranded belt of the foregoing type. V-ribbed belts disclosed with particularity in Kumazaki et al '143 are multi-stranded.

<u>Claim 14</u>

Claim 14 contains all of the limitations of claim 13 and further specifies the length of the chopped aramid fibers is less than 3 mm; the length of the polyester fibers is less than 5 mm; wherein the orientation of both of the chopped aramid and the chopped polyester fibers is transverse to the running direction of the belt; and wherein 5 to 30 parts by total weight of the chopped aramid fibers and the chopped polyester fibers are intermixed in the stock rubber per hundred parts rubber.

Again, Appellants rely upon the argument presented with respect to claim 1 that the core limitations of that claim, also contained in claim 14, are not fairly disclosed in the combination of references relied upon by the Examiner in his rejection.

Claim 14 contains a number of limitations of previous claims, including the relative and absolute lengths of the aramid and polyester fibers intermixed in the rubber body. This particular combination of fiber lengths, as well as relative fiber lengths, has led to the beneficial and unexpected results set forth in the working examples of the subject specification, and as presented

in graphical and tabular form in Figs. 3 – 6 and Figs. 9-12 of the specification.

How can it be said that it was obvious in the sense of 35 USC §103 to produce a power transmission belt with these exceptional and unexpected characteristics, and to meet enhanced durability objectives relative to the standard commercial belt, in light of the disclosures of Ito '226 and Kumazaki et al '143? The answer is, there would have been no such expectation on the part of one skilled in the art. The Paul N. Dunlap Declaration of record, discussed hereinafter, buttresses this conclusion.

[Relates to the second ground of rejection]:

Whether the rejection of claim 8 under 35 USC §103(a) as being unpatentable over Ito '226 in view of Kumazaki et al '143 and further in view of Kodama USP 5,908,520 ("Kodama '520") should be sustained.

II THE EXAMINER HAS FAILED TO ESTABLISH A *PRIMA FACIE* CASE OF OBVIOUSNESS UNDER 35 USC §103(a) OF REJECTED CLAIM 8.

Claim 8

Argument I also applies to claim 8, and is reiterated herein.

Claim 8, dependent on claim 1, further provides that the chopped polyester fiber used in the transmission belt is made from PET fiber, among other high performance polyester materials. The Examiner relies on Kodama '520 to teach use of PET as a type of high modulus polyester fiber.

The Examiner has failed to meet his burden of establishing a *prima facie* case of obviousness of claim 8, for the reasons proffered above in respect to claim 1, and in addition:

- Kodama '520 does not disclose use of PET fibers, nor chopped fibers, nor chopped PET fibers intermixed in the belt body formed of rubber stock
- Kodama '520 teaches, rather, use of elongated (e.g. greater than 200 - 300 mm long) cords, of PET to reinforce the carcass of a pneumatic radial tire [col. 6, lines 13-29 and Fig. 6], not the claimed transmission belt
- Kodama '520's teaching relates to tire cord (analogous to Appellants' longitudinally extending cord of claim 13), not short fiber loaded stock for a transmission belt.

[Relates to the third ground of rejection]:

Whether the rejection of claim 15 under 35 USC §103(a) as being unpatentable over Ito '226 in view of Kumazaki et al '143 and further in view of Kinoshita USP 6,132,328 ("Kinoshita '328") should be sustained.

III THE EXAMINER HAS FAILED TO ESTABLISH A *PRIMA FACIE* CASE OF OBVIOUSNESS UNDER 35 USC §103(a) OF REJECTED CLAIM 15

Claim 15

Argument I also applies to claim 15, and is reiterated herein.

Claim 15 contains all of the limitations of claims 14 and 13, and further specifies that the stock rubber is EPDM, that the rubber includes an organic metal salt mixed in the rubber, and that the belt is used in the transmission of a scooter, the preferred commercial application.[1]

Again, it is submitted that the *prima facie* case of obviousness has not been proved by the Examiner, as argued in respect to claim 1 above.

In respect to the limitation of claim 15 calling for a stock rubber of EPDM to which an organic metal salt is mixed, the Examiner relies on Kinoshita '328 [col. 3, lines 23-43]. This reliance is misplaced. The teaching in that reference is solely that a metal salt of an unsaturated carboxylic acid can be combined with hydrogenated nitrile rubber, not with EPDM as claimed in claim 15. A *prima facie* case of obviousness has not been made out with respect to this limitation as well.

One only has to review the results of the comparative durability test set forth in the application from page 15, line 17 through page 18, line 17 to understand the unexpected benefits flowing from the single strand cogged V-belt used for scooter applications as set forth in claim 15. (The rubber of the conventional example is the commercial standard typically used for a V-belt of a scooter [page 15, lines 18-20]). The conventional belt used a polychloroprene base rubber (in contrast to the claimed EPDM polymer with metal salt added) and 21 phr of chopped para-aramid fibers. The single strand cogged V-belt of the invention used as a comparison conformed to Example A set forth in Table 1 at the top of page 10 of the specification. That is, the belt of the invention used 10 phr aramid of 1 mm length blended with 10 phr polyester of 3 mm length. The total fiber weight was thus 20 phr, very close to that of the conventional scooter belt.

Durability in hours was determined as of the time the V-belt could no longer run. For the conventional example, the bottom rubber broke and the V-belt could not run after about 320 hours

[1] Although not of record, Appellants' commercialized version of its scooter belt conforming to claim 15, sold under the trademark "Powerlink EXII", has been sold extensively in Asia.

on test. In contrast, the V-belt of Example A of the invention broke and could not run after about 680 hours run time. This shows an improvement of more than 100% compared to the commercial standard of the prior art.

There is nothing in either Ito '226 or Kumazaki et al '143 that would have provided such an expectation of success. The claimed combination of claim 15 is non-obvious.

[Relates to all three grounds for rejection]:

1. Whether the rejection of claims 1-7, 9-11 and 13-14 under 35 USC §103(a) as being unpatentable over Ito USP 2001/0039226 ("Ito '226"), in view of Kumazaki et al USP 5,674,143 ("Kumazaki et al '143") should be sustained.

2. Whether the rejection of claim 8 under 35 USC §103(a) as being unpatentable over Ito '226 in view of Kumazaki et al '143 and further in view of Kodama USP 5,908,520 ("Kodama '520") should be sustained.

3. Whether the rejection of claim 15 under 35 USC §103(a) as being unpatentable over Ito '226 in view of Kumazaki et al '143 and further in view of Kinoshita USP 6,132,328 ("Kinoshita '328") should be sustained.

IV EVEN IF THE BOARD BELIEVES, CONTRARY TO APPELLANTS' ARGUMENT, THAT THE EXAMINER HAS MADE OUT A *PRIMA FACIE* CASE OF OBVIOUSNESS, THAT *PRIMA FACIE* CASE HAS BEEN REBUTTED SINCE (a) THERE IS NO TEACHING, SUGGESTION, MOTIVATION OR APPARENT REASON TO COMBINE ITO '226 AND KUMAZAKI ET AL '143 IN THE FASHION ADVANCED BY THE EXAMINER, AND (b) APPELLANTS HAVE PRESENTED STRONG EVIDENCE OF UNEXPECTED RESULTS FLOWING FROM THEIR CLAIMED COMBINATION OF ELEMENTS.

(a) No Teaching, Suggestion, Motivation or Apparent Reason to Combine

The Supreme Court has in *KSR* recognized that a showing of "teaching, suggestion, or motivation" to combine the prior art to meet the claimed subject matter could provide a helpful insight in determining whether the claimed subject matter is obvious under 35 USC §103(a).

As a corollary, the *KSR* Court also indicated that there must be an "apparent reason" to combine the known elements in the fashion proposed by the [Examiner]. This analysis needs to be made explicit.

A rejection based on 35 USC §103(a) must rest on a factual basis, with the facts being interpreted without a hindsight reconstruction of the invention from the prior art. Thus, in the

context of the analysis under Section 103, it is not sufficient to merely identify one reference (Ito '226) that teaches of the limitations of a claim and another (Kumazaki et al '143) that teaches other limitations of a claim to support a rejection based on obviousness. This is because obviousness is not established by combining the basic disclosures of the prior art to produce the claimed invention absent a teaching, suggestion or "apparent reason" that the combination be made. Interconnect Planning Corp. v. Fiel, 227 USPQ 543, 551 (Fed. Cir. 1985); In re Corkhill, 226 USPQ 1005, 1009-110 (Fed. Cir. 1985); and In re Kahn, *infra*. The relevant analysis invokes a cornerstone principle of patent law:

> That all elements of an invention may have been old (the normal situation), or some old and some new, or all new, is ... simply irrelevant. Virtually all inventions are combinations and virtually all are combinations of old elements. Environment Designs v. Union Oil Co. of Cal., 218 USPQ 865, 870 (Fed. Cir. 1983) (Other citations omitted)

As the Court of Appeals for the Federal Circuit has noted, "[w]hen a rejection depends on a combination of prior art references, there must be some teaching, suggestion or motivation to combine the references." Ecolochem, Inc. v. Southern Calif. Edison, 56 USPQ 2d 1065, 1073 (Fed. Cir. 2000). This is because "combining prior art references without evidence of such a suggestion, teaching or motivation simply takes the inventor's disclosure as a blueprint for piecing together the prior art to defeat patentability." Id Accordingly, to establish a rejection under 35 USC §103, a person of ordinary skill in the art must not only have had some motivation to combine the prior art teachings, but also some motivation to combine the prior art teachings in the particular manner claimed . See e.g. In re Kotzab, 55 USPQ 2d 1313, 1318 (Fed. Cir. 2000). And as further discussed in *KSR*, citing In re Kahn with approval, the Examiner must show reasons why the skilled artisan, confronted with the same problems as the inventors and with no knowledge of the claimed invention, would select the elements from the cited prior art references for combination in the manner claimed. See also In re Rouffet *infra*.

Here, the Examiner in support of his rejection of claims 1-11 and 13-15 under 35 USC §103 over Ito '226 in view of Kumazaki et al '143 has conceded that he used hindsight to reconstruct the prior art. He has done so without providing an articulated rationale in support of why that combination should be made, or the apparent reason to combine the elements in the particular fashion advanced. For instance, the Examiner has stated that Kumazaki et al '143 teaches that a belt can be made of a combination of aramid and polyester fibers and that the fibers make up 5 -30 parts by weight of the stock rubber of the belt, for the purpose of reducing the noise in the belt and increasing

its durability [Final Office Action, ¶4, dated April 4, 2007]. But a closer review of the teachings of Kumazaki et al '143, discussed previously, shows that utilizing a combination of aramid and another fiber, in this case nylon as set forth in Tables 1 and 2 in columns 7 and 8 of Kumazaki et al '143 does not result in a belt with increased durability compared to the same belt that is loaded with the same parts per hundred of rubber, but using a single fiber (nylon) rather than the claimed blend of aramid and polyester. In fact, when the results tabulated in Table 2, column 8 of Kumazaki et al '143 are noted carefully, Appellants have shown that the durability, if anything, was higher with the belt being reinforced with a single fiber (nylon) as compared to a blend of aramid with another fiber (nylon). Thus, the skilled person in the art confronted with a transmission belt durability problem would not be inclined, in view of the Kumazaki et al '143 teaching, to shift from the Ito '226 teaching of using a single fiber, rather than a blend. Even if the skilled artisan might consider a blend, there is no suggestion to use a specific blend of longer polyester fibers with shorter aramid fibers.

(b) The Evidence of Unexpected Results

Even assuming *arguendo* that the Examiner has met his burden of presenting a *prima facie* case of obviousness of Appellants' claims in light of Ito '226 together with Kumazaki et al '143, the unexpected and superior results demonstrated by Appellants' claimed invention rebut any such *prima facie* case of obviousness. The Board's attention is first directed to the comparative tensile strength test disclosed in the Examples section of the application starting at page 9, line 15 through page 15, line 15. Each of the examples of the invention and comparative examples (refer to Table 1 on page 10) utilize the same stock rubber (EPDM) but vary the relative lengths of intermixed aramid and polyester fibers. The Examples A – H of the invention utilize longer polyester fibers compared to shorter aramid fibers whereas the Comparative Examples 1 and 2 each use a blend of aramid and polyester fibers of the same length.

As Appellants have argued, why would someone skilled in the art be motivated, or presented with a suggestion, to combine relatively longer polyester fibers with relatively shorter aramid fibers to solve a problem relating to durability of a molded power transmission V-belt? It is submitted that there is none. And where would the prior art provide a reasonable expectation of success, or improved results for making such a combination as claimed by Appellants? It is submitted that there is none.

It is well settled that a *prima facie* case of obviousness is rebutted generally by

showing that the claimed invention achieves unexpected results relative to the prior art. In re Woodruff, 15 USPQ 2d 1934 (Fed. Cir. 1990). The comparative tensile strength tests shown graphically in Figs. 3 and 4 demonstrate unexpected improvement in tensile strength when the claimed blend of longer polyester fibers is combined with shorter aramid fibers. In Fig. 3, for example, Examples A, C, and E of the invention, using 1 mm long aramid fibers with 3 mm long polyester fibers demonstrate significantly improved tensile strength (leading to increased durability) over the comparative Examples 1 and 2 which employed a blend of the same length aramid and polyester fibers, of either 1 mm length or 3 mm length.

The advantages of the invention are even more dramatic when comparing Examples F and H of the invention with Comparative Examples 1 and 2, illustrated in Fig. 4. As stated in the specification on pages 14 and 15, the elongation ratios of the samples of the invention were less than those of the Comparative Examples 1 and 2, thus the strengths against applied tension were greatly superior to the Comparative Examples. In Fig. 4, Examples F and H used, respectively, aramid fibers of 2 mm in length and polyester fibers of 3 mm in length, and aramid fibers of 3 mm in length and polyester fibers of 5 mm in length. The remaining comparative tests compare compression stress (Fig. 5), friction coefficient (Fig. 6), life in hours of the belt or durability (Figs. 9 and 12) and hardness and tension (Figs. 10 and 11) in which the belt of the invention is compared to a conventional scooter belt. These latter comparisons show dramatic improvements between the claimed scooter belts of the invention and standard polychloroprene aramid fiber-loaded scooter belts that were the recent commercial standard. This dramatic improvement in tensile strength and other durability factors for belts is neither disclosed nor suggested in the applied references, or elsewhere in the prior art. There is certainly no reasonable expectation of success, that is, realizing such improvements in durability, that can be gleaned from either of the applied Ito '226 and Kumazaki et al '143 references, taken singly or in combination.

Presented with the foregoing argument during prosecution, the Examiner made the following comments, and issued the following invitation:

> In this case the instant Applicant has modified the length of fibers within the belt structure which will indeed result in some differences in property, but are these difference [s] unexpected? In the absence of any disclosure of what was expected to happen by modifying the lengths of the fibers the examiner cannot ascertain if the results are truly unexpected. Mere allegation that the results of the modification are unexpected or the submission of test data are not significant evidence

> that the results are truly unexpected. The examiner invites the applicants to submit any necessary affidavits or declarations that contain evidence that the results are truly unexpected. [Final Office Action, ¶12, April 4, 2007]

Appellants accepted the Examiner's invitation to present evidence, and submitted the Declaration of Dr. Paul N. Dunlap under 37 CFR §1.132. Although the Dunlap declaration was entered by the Examiner, there is no indication in the record that the Examiner gave it any weight in his consideration of patentability and obviousness. There was absolutely no mention of any of the statements made in the Declaration, or the supporting literature references and treatises relied upon by Dr. Dunlap in his Declaration.

The declarant, Paul N. Dunlap, holds a Ph.D. degree in chemical engineering from California Institute of Technology, has 17 years of industry experience, including about 14 years as a power transmission belt development and materials research engineer. Dr. Dunlap also has published a number of technical articles, has been awarded United States patents and has pending patent applications to his credit. It is submitted that Dr. Dunlap has at least "ordinary skill" in the power transmission belt art. This experience includes, specifically, fiber loaded composites used in various types of automotive and industrial belts [¶4, Dunlap Declaration].

Dr. Dunlap concludes that the results overall graphically depicted in Figs. 3 and 4 of the application are "unexpected" [Declaration, ¶6]; that Comparative Example 2 (10 parts 3 mm aramid fibers blended with 10 parts 3 mm long polyester fibers), would have been expected to have the highest [tensile] strength [Declaration, ¶10]; that the observed ranking of Examples E, F, C and A in relation to Comparative Examples 1 and 2 was "quite unexpected" [Declaration, ¶10]; that in comparison to Comparative Example 2, by shortening the length of the aramid fibers from 3 mm to 1 mm or 2 mm (Examples A and F) the tensile strength <u>increased</u> contrary to his expectation [Declaration, ¶11]; and that the blends of 1 mm aramid and 3 mm polyester fibers performed significantly better than a similar blend of just 3 mm fibers was, in his opinion, another example of "an unexpected and unpredictable result in rubber composite science" [Declaration, ¶12]. Dr. Dunlap supports his analysis and opinion with excerpts from treatises and texts on short-fiber reinforced rubber composites ("SFRR") and theoretical models.

Appellants responded to the Examiner's request to provide a declaration "of what was expected to happen by modifying the lengths of the fibers", and whether the results

were "truly unexpected". Despite the invitation, and the Appellants' care in responding precisely to what the Examiner asked for, the Examiner has appeared to disregard or at least discredit the evidence set forth in the Dunlap Declaration. It is submitted that this constitutes clear error.

As taken from the quote from *KSR* reproduced on page 5 of this Brief:

> Often it will be necessary ...to look to ... the <u>background knowledge possessed by a person having ordinary skill in the art</u> ... [along with other factors] ... to determine whether there was an <u>apparent reason</u> to combine the known elements in the fashion claimed [by the Examiner]. (Emphasis added)

The Dunlap Declaration meets this need by attesting to the lack of predictability in the field of fiber-loaded composites in belts, and both the expected and unexpected results emanating from the controlled experiments reported in the example section of the application. This is compelling evidence from one of ordinary skill in the art as to the lack of propriety of the fashioned obviousness rejection.

If the unexpected results set forth in the application of the claimed invention can then be accepted for what they are, as they have not been contested by the Examiner, where does the prior art teach, state, suggest or even <u>hint</u> that the use of blends of relatively short aramid fibers with relatively long polyester fibers in the rubber matrix of a power transmission belt will provide a reasonable expectation of success? Or produce any improvement in belt performance, or solve any of the durability or other problems confronted by Appellant? ... <u>nowhere</u>.

Conclusion

In light of the foregoing, it is submitted that the Examiner has failed to meet his burden of establishing a *prima facie* case of obviousness in this case. Even if the Board believes a *prima facie* case has been made out, although Appellants strongly contends to the contrary, it is submitted that Appellants have rebutted the *prima facie* case. The Board is requested to reverse the rejection of claims 1-11 and 13-15 under 35 USC §103.

Respectfully submitted,

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Denver, Colorado
Dated: 15 February 2008

CLAIMS
APPENDIX

1. (Original) A transmission belt comprising:

    a belt body which is molded from a stock rubber;

    chopped aramid fibers that are intermixed in said belt body and oriented in a predetermined direction of said belt body; and

    chopped polyester fibers that are intermixed in said belt body and oriented in said predetermined direction;

    wherein chopped polyester fibers are longer than said chopped aramid fibers.

2. (Original) A transmission belt according to claim 1, wherein said chopped aramid fibers and said chopped polyester fibers are oriented in a width direction of said belt body.

3. (Original) A transmission belt according to claim 1, wherein 5 to 30 parts by total weight of said chopped aramid fibers and said chopped polyester fibers are intermixed in said stock rubber with respect to 100 parts of a rubber component of said stock rubber.

4. (Original) A transmission belt according to claim 1, wherein a length of said chopped aramid fibers is less than 3 mm.

5. (Original) A transmission belt according to claim 1, wherein a length of said chopped polyester fibers is less than 5 mm.

6. (Previously Amended) A transmission belt according to claim 1, wherein a rubber component of said stock rubber is one of ethylene propylene copolymer, ethylene propylene diene terpolymer, nitrile butadiene rubber, hydrogenated nitrile butadiene rubber, and chloroprene rubber.

7. (Original) A transmission belt according to claim 1, wherein said chopped polyester fibers are subjected to a treatment involving coating with a resorcinol-formalin-latex.

8. (Previously Amended) A transmission belt according to claim 1, wherein said chopped polyester fiber is one of chopped PET fiber, chopped polyethylene isopthalate fiber,

chopped polybutylene terphthalate fiber, chopped fiber obtained from a ring-opening polymer of β-propionelactone, and chopped fiber of a polymer obtained by polymerizing dimethyl terephthalate and 1,4-cyclohexanedimethanol.

9. (Original) A transmission belt according to claim 1, wherein said chopped aramid fiber is one of chopped para aramid fiber and chopped meta aramid fibers.

10. (Original) A transmission belt according to claim 1, wherein said transmission belt is a V-belt.

11. (Original) A transmission belt according to claim 10, wherein said V-belt is a cogged V-belt.

12. (Withdrawn) A transmission belt comprising:

a belt body which is obtained and molded from a stock rubber in which chopped aramid fibers and chopped polyester fibers are intermixed;

said chopped polyester fibers being longer than said chopped aramid fibers;

wherein said chopped aramid fibers and said chopped polyester fibers are oriented in a predetermined direction of said belt body.

13. (Previously added) A power transmission belt of the single strand cogged V-belt type comprising:

(a) a belt body molded from a stock rubber, comprising a top rubber layer, a bottom rubber layer, and a cord extending in the longitudinal direction of the belt embedded between the top rubber layer and the bottom rubber layer, said bottom rubber layer being provided with cogs formed in wave shapes in the longitudinal direction of the belt;

(b) chopped aramid fibers that are intermixed in said belt body in both of said top rubber layer and said bottom rubber layer and oriented in a predetermined direction of said belt body;

(c) chopped polyester fibers that are intermixed in said belt body in both of said top rubber layer and bottom rubber layer and oriented in said predetermined direction;

(d) wherein said chopped polyester fibers have a length which is longer than said

chopped aramid fibers.

14. (Previously added) The power transmission belt of claim 13 wherein a length of said chopped aramid fibers is less than 3mm; wherein a length of said polyester fibers is less than 5mm; wherein the orientation of both of said chopped aramid fibers and said chopped polyester fibers is transverse to the running direction of the belt; and wherein 5 to 30 parts by total weight of said chopped aramid fibers and said chopped polyester fibers are intermixed in said stock rubber per 100 parts rubber.

15. (Previously added) The power transmission belt of claim 14 in which the stock rubber is formed of EPDM, in which an organic metal salt is mixed, and the belt is used in the transmission of a scooter.

EVIDENCE APPENDIX

Declaration of Paul N. Dunlap dated June 21, 2007

IN RE: U.S. Serial No. 10/523,708
FOR: TRANSMISSION BELT
INVENTOR: SATO, Yoshitaka et al.
ASSIGNEE: Gates Corporation
DOCKET NO: GUA UTO318

DECLARATION

I, Paul N. Dunlap, under penalty of law hereby declare as follows:

1. I reside at 6283 S. Galena Way, Englewood, CO 80111, United States.

2. In 1978 I obtained a Bachelor of Science degree in Chemical Engineering with special honors from the University of Colorado. In 1981 I was awarded Master of Science and in 1986 Doctor of Philosophy degrees in Chemical Engineering from California Institute of Technology. I have six refereed publications in the fields of polymer solution rheology and composites, and am named as an inventor on two U.S. patents (U.S. Pat. Nos. 7,078,104 and 7,166,678) and on two patent applications pending before the USPTO.

3. From 1986 – 1990 I was employed at Corning, Incorporated where I conducted research on glass/polymer composites.

4. From 1990 until late 2003 I was employed by The Gates Corporation, assignee of the captioned patent application, in their power transmission belt division. My focus at Gates prior to late 2003 has been in belt development and materials research (for belts), which has led to commercialization of new products and the engineering of production processes. I have dealt with a wide variety of power transmission belts and elastomeric compositions at Gates including fiber-loaded compositions for reinforced rubber belts. I am quite familiar with Gates' commercial line of automotive and industrial rubber belts on the one hand (V-type, V-ribbed and synchronous), and polyurethane belts on the other (V-type and synchronous), and their methods of production.

5. From late 2003 through 2005, I was employed by The Gates Corporation half time as a Patent Agent, having become registered in early 2003. At the same time I attended law school and was award the Juris Doctor degree in December 2005 by the University of Colorado-Boulder School of Law. I have been employed full time as Patent Counsel by Gates since 2006, USPTO registration number 52,840. I have written and prosecuted a number of patent applications relating to fiber-loaded v-belts and multi-v-ribbed belts, drawing on my past experience with Gates.

6. I have been asked to comment, as an expert in the field of rubber compounding for belts, on the results presented in U.S. Patent Application 10/523,708 – in particular, whether the results in Figures 3 and 4 are unexpected. In my opinion, certain results in Figures 3 and 4 are unexpected. I base this on three separate approaches: (1) the general nature of the short-fiber reinforced rubber ("SFRR") composite; (2) predictions based on theoretical and empirical models; and (3) the empirical trends found in the data of Figures 3 and 4.

<u>(1) General nature of SFRR.</u>

7. Short-fiber reinforced rubber composites are generally known to be unpredictable in certain physical properties. One such unpredictable property is tensile strength. While composite modulus is generally predictable from a knowledge of the rubber matrix and fiber moduli, the fiber concentration, and the fiber dimensions and orientation, composite tensile strength depends on these plus a number of additional factors which are extremely unpredictable. Tensile strength depends, in addition, on the strength of the matrix and fiber, the degree of fiber dispersion, the extent of fiber interaction, stress concentrations, the matrix wetting of the fiber, and the matrix adhesion to the fiber, i.e., the interfacial bond strength. The unpredictability arises in large part from the dependence of fiber dispersion and fiber length on the mixing or other processing conditions applied to the composite. *See e.g.*, Lloyd A. Goettler, "Short-Fiber Rubber Composites," at Table 2 and p. 241, 244, in Anil K. Bhowmick & Howard L. Stephens, eds., "Handbook of Elastomers: New Developments and Technology," Marcel Dekker, NY, pp. 215-248 (1988) ("It is of interest that the tensile strength of discontinuous composites is not in proportion to the corresponding strength of the reinforcing fibers themselves. Other parameters relating to the composite structure are of greater consequence (see Table 2)." Goettler describes a number of examples in the literature where composite strength results are contrary to expectation, or non-linear, or more dependent on processing than on physical properties. *Id.* at p. 242. Indeed, in a more recent edition of the same book, the author focuses on the dominant relationship between processing and structure and the resulting effects on physical properties. Lloyd A. Goettler & William F. Cole, "Short Fiber-Filled Rubber Composites," in Anil K. Bhowmick & Howard L. Stephens, eds., "Handbook of Elastomers," 2d ed., Marcel Dekker, NY, pp. 241-264 at p. 241 (2001).

8. In this case, the general unpredictability of composite tensile strength is implicitly seen in the specification of the captioned patent application. The inventors make a valiant attempt to explain the mechanism of the invention in terms of processing conditions, degree

of dispersion, fiber orientation, and fiber properties (page 6-7). On one hand, these explanations are very qualitative, hand-waving arguments. On the other hand, these explanations are entirely consistent with the general state of the art regarding our understanding of how short-fiber rubber composites work. In short, the tensile strength of a unique combination of fiber materials and lengths is best determined by experiment and explained by hindsight reasoning, not predicted from first principles.

(2) Theory.

9. The theoretical models used for short-fiber reinforced rubber composites ("SFRR") have been described in various references, but fall very short of rendering tensile strength predictable. *See e.g.*, L.A. Goettler & K.S. Shen, "Short Fiber Reinforced Elastomers," Rubber Chem. & Tech., v. 56, pp. 619-638 (1983); S. Abrate, "The Mechanics of Short-Fiber-Reinforced Composites: A Review," Rubber Chem. & Tech., v. 59, pp. 384-404 (1986); M. Fukuda, T. Shioyama, & Y. Mikama, "V-Belt and Fan Belt Manufacturing Technology," in A.K. Bhowmick, M.M. Hall, & H.A. Benarey, eds., "Rubber Products Manufacturing Technology," Marcel Dekker, NY, pp. 593-649 (1994). What each of these reviews discusses is the rather successful theoretical modeling of modulus, and in contrast, the rather limited modeling of **strength** of rubber composites. The available theoretical predictions for tensile strength of SFRR may be summarized as follows. Tensile strength is expected to initially decrease as volume fraction fiber loading increases at very low loadings, reaching a minimum. (*See e.g.*, Abrate, p. 398). Then tensile strength is expected to increase until a critical loading is reached (Abrate, at p. 398, relates a measured critical loading of 10 phr in one study) beyond which strength of the composite is greater than the rubber matrix alone, but only if good bonding exists. The critical loading depends on fiber length. (Goettler, p. 241). Whether, the predicted behavior is observed in a given experiment depends on degree of bonding between fiber and matrix, and of course the degree of orientation and dispersion. (*Id.*). Theoretically, the tensile strength will approach a maximum value as fiber length increases, orientation is complete, and bonding is perfected. (Abrate, p. 386; Goettler & Shen, p. 628). Stronger fibers are expected to require a longer length to reach maximum strength in the composite, which will be a higher strength than with a weaker fiber. (*See* Abrate, p. 399). In blends of different fiber types, expectations are that the longer type tends to dominate the strength, unless it cannot be dispersed, oriented, or bonded as well as the shorter type, (noting that it is more accurate to compare based on length-to-diameter ratio). (*Id.*) One quantitative approach (*see* Abrate, at p. 399, Eq. 46) treats the composite strength as a straight-forward

linear sum of the matrix and fiber contributions, however, the fiber contribution is reduced by two empirical efficiency factors (less than 1) to account for processing and bonding effects.

10. In the present case, the data is measured at certain fixed fiber lengths and loadings and in the same matrix, most likely at a loading at or above the critical loading. Assuming perfect orientation, dispersion, and bonding for all samples, the example with the greatest amounts of the longest and strongest fibers is expected to have the highest tensile strength. Conex aramid is generally about the same to a little lower in strength compared to polyester, but being finer has a greater length-to-diameter ratio at the same length. Thus, my expectation of the examples in Table 1 would be as follows. Examples G and H, having the longest fibers (2, 3, & 5 mm), would be expected to have the highest strength. Of the samples containing only 1-mm and 3-mm fibers, Comparative example 2 would be expected to have the highest strength, because Comparative example 2 has 20 total parts of 3-mm fibers. Example E would be expected to follow closely behind or perhaps be equivalent to Comparative example 2, because it has the next greatest amount of the 3-mm fibers (15 parts), and it also has 15 parts of the shorter fiber. Likewise Example F should have a little lower strength than Comparative example 2 because the 2-mm fibers in example F reduce the average fiber length. Then Example A should be slightly better than Example C, because of its greater average fiber length. Thus, of the examples compared in Fig. 3, Comparative example 2 would be expected to have the highest strength. The observed ranking, E & F > C > A > 1 > 2, is thus quite unexpected. Especially, the fact that Examples C, F, and A have greater strength than Comparative example 2 is a surprise.

<u>(3) Empirical results.</u>

11. Finally, considering the tensile strength data of the present application by itself, in light of known trends in SFRR properties, there are surprises. Comparing Comparative example 2 to Examples A, F, and C reveals two surprises. First, comparing Comparative example 2 to Example A & F, we see that shortening the length of the aramid fibers from 3-mm to 1-mm or 2-mm increases the tensile strength of the composite, contrary to my expectations. (Longer fibers, or greater average fiber length, are generally expected to give higher strength.) Second, comparing Comparative example 2 to Example C, we see that reducing the amount of 3-mm polyester fibers, and replacing them with shorter 1-mm aramid fibers at the same total loading also increases the tensile strength of the composite, contrary to normal expectations. (At the same total loading, the sample with longer average fiber length

should have higher strength. Note that even on the basis of length-to-diameter ratio, 1-mm aramid is "shorter" than 3-mm polyester.)

Conclusion

12. Thus, in my opinion, tensile strength of short-fiber rubber composites is not easily predicted and subject to many process-specific and material-specific uncertainties. Even in a related series of experiments, unexpected trends have been demonstrated in the literature. Theoretical approaches may be useful in hindsight to explain results, but are little use in predicting the strength of new combinations. (E.g., as stated in Abrate at 391, "the Halpin-Tsai equations, provide hindsight into the phenomenon of reinforcement by short fibers.") This particular case, where a blend of 1-mm aramid and 3-mm polyester fibers performs significantly better than a similar blend of just 3-mm fibers, is, in my opinion, another example of an unexpected and unpredictable result in rubber composite science.

13. I declare the foregoing, under penalty of perjury, to be true.

Date: 6-21-2007

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RELATED PROCEEDINGS APPENDIX

None.